Land Use and Invasive Species in Rhode Island Riparian Zones

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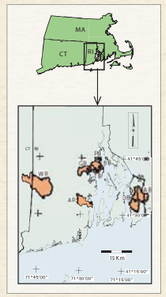
Abstract

Riparian zones are productive ecological systems that are highly susceptible to invasions by non-native plant species. Disturbance of the surrounding landscape increases this susceptibility and may have implications for wildlife habitat. This study was conducted to assess the relationship of watershed land use with riparian vegetation and the occurrence of invasive plant species. Our objective was to compare the structure and species composition of the vegetation in riparian corridors of selected Rhode Island wadeable streams along a range (4-59%) of Residential Land Use (RLU) in the watershed. We used field transects to measure the extent of tree, shrub, and herbaceous ground cover, and a Geographic Information System to document larger-scale land cover attributes. The observed plant species were characterized according to native or invasive status, distribution by vegetative layer, and potential use as habitat for foraging birds. This study showed that overall riparian vegetation cover and density decreased with increasing residential land use, while invasive-species richness and cover increased. With increasing urbanization, available bird habitat within the watersheds was altered; canopy habitat was reduced and edge habitat increased, resulting in a change of species composition of breeding birds.

Methods

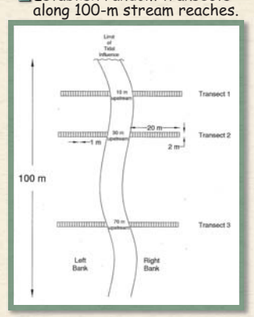
- Delineate watershed with a GIS



Riparian site locations

Sites	Codes	% RLU
Wood River	WR	4
Adamsville Brook	AB	12
Donovan Bk	DB	17
Annaquatucket R	AR	24
Buckeye Bk	BB	29
Gorton Bk	GB	38
Tuscatucket Bk	TB	53
Passeonkquis Bk	PB	59

- Establish random transects along 100-m stream reaches.



Sampling design for random transects

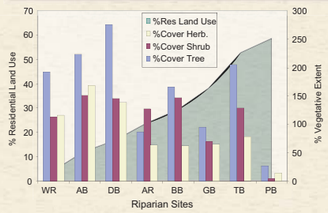
- Measure sampling plots

Establishing a transect

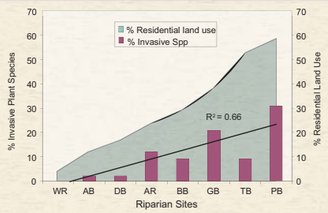
- Identify and record species at each of three vegetation layers

Checking for vegetation cover with densitometer

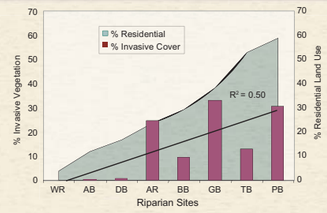
RESULTS



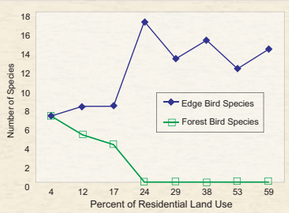
- Vegetation decreased at all layers with increasing % residential land use (RLU)



- Percent invasive species increased with % RLU



- Density of invasive cover directly correlated with increasing % RLU



- Bird habitat was altered, favoring edge species but not forest birds[1]

[1]Lussier, S.M., Enser, R.W., daSilva, S.N., and Charpentier, M. 2006. Effects of Habitat Disturbance from Residential Development on Breeding Bird Communities in Riparian Corridors. Environmental Management 38: 504-521.

[2]Gough, G.A., Sauer, J.R., Iliff, M. Patuxent Bird Identification Infocenter. 1998. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD. http://www.mbr-pwrc.usgs.gov/id/frambtid/infocenter.html

[3]http://www.wildbirdphotos.com

- Some bird species lost in higher % residential areas

Percent occurrence of invasive plant species at all sites

Riparian Invasive Vegetation	Wood River	Adamsville Brook	Donovan Brook	Annaquatucket River	Buckeye Brook[1]	Gorton Brook	Tuscatucket Brook	Passeonkquis Brook	Percent Dominance
Multiflora Rose (*Rosa multiflora*)	0.8%		29.3%	15.8%	4.0%	2.2%	27.8%	30.7%	**43.5%**
Asiatic Bittersweet (*Celastrus orbiculatus*)				26.0%	2.7%	34.3%	5.8%	5.2%	**29.1%**
Black Locust (*Robinia pseudoacacia* L.)							17.3%		**6.8%**
Japanese Knotweed (*Polygonum cuspidatum*)						15.2%		0.7%	**6.2%**
Norway Maple (*Acer platanoides* L.)					1.3%			9.2%	4.1%
Tree of Heaven (*Ailanthus altissima*)				8.7%					3.4%
Japanese Barberry (*Berberis thungergii*)		0.2%		1.7%		5.8%			3.0%
Morrow's Honeysuckle (*Lonicera morrowii*)				4.0%	0.8%	2.8%			3.0%
Autumn Olive (*Elaeagnus umbellate*)				0.3%		0.8%			0.4%
False or Dull-leaf Indigo (*Amorpha fruticosa* L.)						0.7%			0.3%
Bittersweet or Climbing Nightshade (*Solanum dulcamara* L.)							0.2%	0.2%	0.2%
Total % cover among all vegetation	0.8%	0.2%	29.3%	**56.5%**	8.8%	**61.8%**	**51.1%**	**46.0%**	
Percent Residential Land Use	4%	12%	17%	24%	29%	38%	53%	59%	

[1]Buckeye Brook's riparian zone is surrounded by wetland and relatively undeveloped.

The top four invasive plant species at our sites

Multiflora Rose | Asiatic Bittersweet | Black Locust | Japanese Knotweed

Pearson correlation coefficients showing relationships among vegetation indices

	Watershed Metrics										Reach Metrics						
	% Residential Land Use	% Forest	% Wetland	% Forest & Wetland	% Canopy (200 m)	% Canopy (500 m)	Edge:Area Ratio (200m/m²)	Edge:Area Ratio (500m/m²)	Riparian Zone (Acres)	% Tree Cover	% Shrub Cover	% Total Vegetation Cover	% Invasive Sp. Cover (% of Total Veg. Cov)	% Extent Invasive	% Extent Total Veg.	% Invasive sp. (richness)
% Imperv Surf	1.000															
% Residential	**0.795**	1.000														
% Forest	-0.813	-0.847	1.000													
% Wetland	-0.631	-0.515	0.187	1.000												
% For+Wet	-0.944	-0.919	0.911	0.575	1.000											
% Canopy (200m)	-0.560	-0.668	0.731	0.299	0.735	1.000										
% Canopy (500m)	-0.746	-0.846	0.830	0.482	0.895	0.931	1.000									
Edge:Area (200m)	0.076	0.354	-0.364	0.017	-0.294	-0.811	-0.652	**1.000**								
Edge:Area (500m)	0.597	0.887	-0.759	-0.354	-0.779	-0.821	-0.903	0.720	1.000							
Riparian (ac)	-0.535	-0.617	0.758	0.010	0.644	0.776	0.738	-0.546	-0.704	1.000						
% Tree Cover	-0.296	-0.571	0.319	0.553	0.496	0.726	0.674	-0.568	-0.617	0.434	1.000					
% Shrub Cover	-0.231	-0.637	0.283	0.429	0.412	0.360	0.415	-0.186	-0.510	0.335	0.799	1.000				
% Total Veg Cover	-0.396	-0.684	0.412	0.562	0.578	0.696	0.685	-0.483	-0.668	0.524	0.971	0.888	1.000			
% Invasive Cover	0.415	0.707	-0.538	-0.458	-0.644	-0.794	-0.824	0.570	0.752	-0.630	-0.896	-0.741	-0.896	1.000		
% Extent Invasive	0.477	0.447	-0.474	-0.399	-0.574	-0.725	-0.787	0.522	0.598	-0.598	-0.483	-0.117	-0.431	0.721	1.000	
% Extent Tot Veg	-0.396	-0.684	0.413	0.562	0.579	0.696	0.686	-0.482	-0.668	0.525	0.971	0.889	1.000	-0.896	-0.431	1.000	
% Invasive sp.	0.480	0.812	-0.612	-0.460	-0.700	-0.709	-0.753	0.433	0.735	-0.567	-0.887	-0.888	-0.938	0.915	0.427	0.939	1.000

Significant at <0.05; critical value =0.707 (Zar, 1999)

Significant at <0.10; critical value = 0.621 (Zar, 1999)

Summary

- ✓ Riparian zones are vulnerable to residential land use.
- ✓ Increased disturbance can affect plant species diversity.
- ✓ Changes in riparian vegetative habitat can affect wildlife.
- ✓ Monitoring can help to determine status and need for protection.
- ✓ Watersheds with less development and fragmentation are good candidates for preservation.